INDOOR AIR QUALITY ASSESSMENT

Field Elementary School
99 School Street
Weston, Massachusetts 02493

Prepared by:
Massachusetts Department of Public Health
Center for Environmental Health
Emergency Response/Indoor Air Quality Program
December 2005

Background/Introduction

At the request of a parent, the Massachusetts Department of Public Health's (MDPH) Center for Environmental Health (CEH) provided assistance and consultation regarding indoor air quality at the Field Elementary School (FES), 99 School Street, Weston, Massachusetts. The request was prompted by parental concerns of possible mold growth in the carpeting of a ground floor classroom (classroom 9).

On November 17, 2005, the school was visited by Cory Holmes, an Environmental Analyst in CEH's Emergency Response/Indoor Air Quality (ER/IAQ) Program. Mr. Holmes was accompanied by Fred Blake, Head Custodian, during the assessment.

The FES is two-story brick building that was constructed in the late 1950s as the Weston High School. Some interior renovations were reportedly made in 1995; however, the majority of building components are original. The building has a history of water penetration. School officials reported that over the summer of 2004 substantial efforts were made to restore the integrity of the building envelope to prevent water penetration. These efforts included excavating and water proofing exterior walls, recaulking of windows along the front side of the building, and regrading of surfaces around the building. The building contains general classrooms, a gymnasium, library, an art room, music room, kitchen, cafeteria and administrative offices.

Methods

Air tests for carbon dioxide, carbon monoxide, temperature and relative humidity were conducted with the TSI, Q-TRAK™ IAQ Monitor, Model 8551. CEH staff also performed a visual inspection of building materials for water damage and/or microbial growth. Moisture content of porous building materials (e.g., carpeting, wood) was measured with Delmhorst, BD-2000 Model, Moisture Detector with a Delmhorst Standard Probe. Screening for total volatile organic compounds (TVOCs) was conducted using a Thermo Environmental Instruments Inc., Model 580 Series Photo Ionization Detector (PID).

Results

The school houses elementary school students in grades 4 and 5 with a student population of approximately 390 and a staff of approximately 65. Tests were taken during normal operations at the school, and results appear in Table 1. Moisture readings appear in Table 2.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were above 800 parts per million parts (ppm) of air in three of eighteen areas surveyed, indicating adequate ventilation in the majority of areas surveyed during the assessment. Fresh air in classrooms is supplied by a unit ventilator (univent) system (Picture 1). Univents are designed to draw air from outdoors through a fresh air intake located on the exterior walls of the building (Picture 2) and return air through an air intake located at the base of each unit (Figure 1). Fresh and return air are mixed and filtered, then heated and provided to classrooms through an air diffuser located in the top of the unit. Univents are reportedly original equipment, over 50 years old. Univents of this age are difficult to maintain because replacement parts are often unavailable. Most the univents were operating during the assessment. The univent in classroom 9 was inoperable. Mr. Blake reported that the univent was on order to be repaired. Several other univents were found deactivated by occupants. Obstructions to airflow, such as papers and books stored on univents and bookcases, carts and desks in front of univent returns, were seen in a few classrooms. In order for univents to provide fresh air as designed, units must remain activated and allowed to operate unobstructed while rooms are occupied.

Exhaust ventilation in classrooms is provided by ducted, grated wall or ceiling vents (Pictures 3 and 4) powered by rooftop motors. Several rooftop exhaust vents were also reported to be on order to be repaired; therefore no means of mechanical exhaust for these classrooms was being provided during the assessment. A number of exhaust vents were also obstructed by desks, bookcases and other items (Picture 4). As with the univents, in order to function properly, exhaust vents must be activated and remain free of obstructions. In addition, the location of some exhaust vents can limit exhaust efficiency. In several rooms, exhaust vents are located near hallway doors. When these classroom doors are open, exhaust vents become blocked (Picture 5). Exhaust vents in these rooms will also tend to draw air from both the hallway and the classroom, reducing the effectiveness of the exhaust vent to remove common environmental pollutants.

Mechanical ventilation for the computer room is provided by an air handling unit (AHU) located in a mechanical room. Supply air is ducted to the room via wall-mounted vents and ducted back to the AHU through wall-mounted return vents. This system was operating during the assessment.

To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a univent and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). The date of the last balancing of these systems was not available at the time of the assessment.

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The MDPH uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, consult Appendix A.

Temperature measurements ranged from 70° F to 76° F, which were within the MDPH recommended comfort range. The MDPH recommends that indoor air temperatures be maintained in a range of 70° F to 78° F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. In addition, it is difficult to control temperature and maintain comfort without operating the ventilation equipment as designed (e.g., univents and exhaust vents inoperable, obstructed and/or deactivated).

The relative humidity measured in the building ranged from 27 to 39 percent, which were below and/or close to the lower limit of the MDPH recommended comfort range the day of the assessment. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

As previously mentioned, concerns were expressed regarding possible mold growth in carpeting in classroom 9, which is located on the ground floor. In order for building materials to support mold growth, a source of moisture is necessary. Identification and elimination of water moistening building materials is necessary to control mold growth. Building materials with increased moisture content over normal concentrations may indicate the possible presence of mold growth. Identification of the location of materials with increased moisture levels can also provide clues concerning the source of water supporting mold growth.

In an effort to ascertain moisture content of carpeting, moisture readings were taken in classroom 9 and in classroom 7 for comparison. As indicated, moisture content was measured with a Delmhorst Moisture Detector equipped with a Delmhorst Standard Probe. The Delmhorst probe is equipped with three lights that function as visual aids that indicate moisture level. Readings that activate the green light indicate a sufficiently dry or low moisture level, those that activate the yellow light indicate borderline conditions and those that activate the red light indicate elevated moisture content. No elevated moisture readings were measured during the assessment (Table 2). In addition, a thorough visual examination of classroom 9 was conducted. No visible water damage, mold growth or associated odors were observed and/or detected during the assessment.

Several classrooms contained a number of plants. Plants, soil and drip pans can serve as sources of mold growth, and thus should be properly maintained. Plants should have drip pans to prevent wetting and subsequent mold colonization of window frames. Plants should also be located away from ventilation sources to prevent aerosolization of dirt, pollen or mold (Picture 7).

Spaces between the sink countertop and backsplash were also seen in a few classrooms (Picture 8). Improper drainage or sink overflow can lead to water penetration into countertop wood, the cabinet interior and areas behind cabinets. If these materials become wet repeatedly they can provide a medium for mold growth.

The exterior of the building was examined for potential pathways for water penetration. MDPH staff observed open utility holes in exterior walls (Picture 9) and a large crack in brickwork along the front of the building (Picture 10). Repeated water penetration can result in the chronic wetting of building materials and potentially lead to microbial growth. In addition, these large cracks/holes in the exterior wall may provide a means of egress for pests/rodents into the building.

Although exterior window caulking was replaced in some areas, caulking around windows and frames in the remaining areas of the building was crumbling/damaged indicating that the water seal is no longer intact (Pictures 11 through 13). Replacement of caulking and repairs of window leaks are necessary to prevent water penetration and subsequent damage to building materials, which can lead to mold growth.

The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommends that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If porous materials are not dried within this time frame, mold growth may occur. Water-damaged porous materials cannot be adequately cleaned to remove mold growth. The application of a mildewcide to moldy porous materials is not recommended.

Finally, a bird's nest was observed between fresh air intake louvers of the gymnasium AHU (Picture 14). At the time of the assessment, MDPH staff recommended removing the nest and disinfecting the intake louvers using an antimicrobial agent. Birds can be a source of disease, and bird wastes and feathers can contain mold and mildew, which can be irritating to the respiratory system. No obvious signs of bird roosting inside the building were noted by MDPH staff nor were such signs reported by occupants.

Other IAQ Evaluations

Indoor air quality can be adversely impacted by the presence of respiratory irritants, such as products of combustion. The process of combustion produces a number of pollutants. Common combustion products include carbon monoxide, carbon dioxide, water vapor and smoke (fine airborne particle material). Of these materials, exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the school environment, MDPH staff obtained measurements for carbon monoxide and PM2.5.

Carbon monoxide is a by-product of incomplete combustion of organic matter (e.g., gasoline, wood and tobacco). Exposure to carbon monoxide can produce immediate and acute health affects. Several air quality standards have been established to address carbon monoxide pollution and prevent symptoms from exposure to these substances. The MDPH established a corrective action level concerning carbon monoxide in ice skating rinks that use fossil-fueled ice resurfacing equipment. If an operator of an indoor ice rink measures a carbon monoxide level over 30 ppm, taken 20 minutes after resurfacing within a rink, that operator must take actions to reduce carbon monoxide levels (MDPH, 1997).

ASHRAE has adopted the National Ambient Air Quality Standards (NAAQS) as one set of criteria for assessing indoor air quality and monitoring of fresh air introduced by HVAC systems (ASHRAE, 1989). The NAAQS are standards established by the US EPA to protect the public health from 6 criteria pollutants, including carbon monoxide and particulate matter (US EPA, 2000a). As recommended by ASHRAE, pollutant levels of fresh air introduced to a building should not exceed the NAAQS (ASHRAE, 1989). The NAAQS were adopted by reference in the Building Officials & Code Administrators (BOCA) National Mechanical Code of 1993 (BOCA, 1993), which is now an HVAC standard included in the Massachusetts State Building Code (SBBRS, 1997). According to the NAAQS established by the US EPA, carbon monoxide levels in outdoor air should not exceed 9 ppm in an eight-hour average (US EPA, 2000a).

Carbon monoxide should not be present in a typical, indoor environment. If it is present, indoor carbon monoxide levels should be less than or equal to outdoor levels. For the FES, indoor carbon monoxide concentrations were non-detect or ND (Table 1). Carbon monoxide levels measured outside the school were also ND.

As previously mentioned, the US EPA also established NAAQS for exposure to particulate matter. Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. According to the NAAQS, PM10 levels should not exceed 150 micrograms per cubic meter ($\mu g/m^3$) in a 24-hour average (US EPA, 2000a). This standard was adopted by both ASHRAE and BOCA. Since the issuance of the ASHRAE standard and BOCA Code, US EPA proposed a more protective standard for fine airborne particles. This more stringent PM2.5 standard requires outdoor air particulate levels be maintained below 65 $\mu g/m^3$ over a 24-hour average (US EPA, 2000a). Although both the ASHRAE standard and BOCA Code adopted the PM10 standard for evaluating air quality, MDPH uses the more protective PM2.5 standard for evaluating airborne particulate matter concentrations in the indoor environment.

Outdoor PM2.5 concentrations were measured at 10 $\mu g/m^3$ (Table 1). PM2.5 levels measured indoors ranged from 9 to 19 $\mu g/m^3$, which were below the NAAQS PM2.5 level of 65 $\mu g/m^3$ in all areas. Frequently, indoor air levels of particulates (including PM2.5) can be at higher levels than those measured outdoors. A number of mechanical devices and/or activities that occur in schools can generate particulate during normal operations. Sources of indoor airborne particulates may include but are not limited to particles generated during the operation of fan belts in the HVAC system, cooking in the cafeteria stoves and microwave ovens; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner; and heavy foot traffic indoors.

Indoor air quality can also be impacted by the presence of materials containing volatile organic compounds (VOCs). VOCs are substances that have the ability to evaporate at room temperature. Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs. In an effort to determine whether VOCs were present in the building, air monitoring for TVOCs was conducted. Outdoor air samples were taken for comparison. Outdoor TVOC concentrations were ND (Table 1). Indoor TVOC measurements throughout the building were also ND.

Please note, TVOC air measurements are only reflective of the indoor air concentrations present at the time of sampling. Indoor air concentrations can be greatly impacted by the use of TVOC-containing products. While no measurable TVOC levels were detected in the indoor environment, VOC-containing materials were noted. Several classrooms contained dry erase boards and dry erase board markers. Materials such as dry erase markers and dry erase board cleaners may contain VOCs, such as methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve (Sanford, 1999), which can be irritating to the eyes, nose and throat.

The main office contained a photocopier, which can produce irritating odors during use (Picture 15). VOCs and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, 1992). This area in not equipped with local exhaust ventilation to help reduce excess heat and odors.

Cleaning products were found beneath sinks and on counter tops in classrooms (Picture 16). Cleaning products contain chemicals (such as bleach or ammonia-related compounds), which can be irritating to the eyes, nose and throat. These items should be stored properly and out of the reach of students.

Several other conditions that can affect indoor air quality were noted during the assessment. In some classrooms, items were observed on windowsills, tabletops, counters, bookcases and desks. The large number of items stored in classrooms provides a source for dusts to accumulate. These items (e.g., papers, folders, boxes) make it difficult for custodial staff to clean. Items should be relocated and/or be cleaned periodically to avoid excessive dust build up.

Two portable air purifiers were located in classroom 9. This equipment has air filters that should be cleaned or changed as per the manufacturer's instructions to avoid the reaerosolization of dusts and particulates.

Finally, several classroom univents contained metal/mesh filters (Picture 16). The material used for filter media provides minimal filtration of respirable particulates. In order to decrease aerosolized particulates, disposable filters with an increased dust spot efficiency can be installed in these units. The dust spot efficiency is the ability of a filter to remove particulates of a certain diameter from air passing through the filter. Filters that have been determined by ASHRAE to meet its standard for a dust spot efficiency of a minimum of 40 percent would be sufficient to reduce airborne particulates (Thornburg, 2000; MEHRC, 1997; ASHRAE, 1992). Note that increased filtration can reduce airflow produced by the unit by increased resistance (called pressure drop). Prior to any increase of filtration, each piece of air handling equipment should be evaluated by a ventilation engineer to ascertain whether they can maintain function with more efficient filters. The age and function of some univents may preclude any attempt to increase filter efficiency.

Conclusions/Recommendations

Although no evidence of visible water damage, mold growth or associated odors were observed and/or detected in classroom 9, several issues were identified that could result in potential water penetration that could result in mold growth. The general building conditions, maintenance, work hygiene practices and the condition/age of HVAC equipment, if considered individually, present conditions that could degrade indoor air quality. When combined, these conditions can serve to further degrade indoor air quality. Some of these conditions can be remedied by actions of building occupants. Other remediation efforts will require alteration to the building structure and equipment. For these reasons, a two-phase approach is required for remediation. The first consists of **short-term** measures to improve air quality and the second consists of **long-term** measures that will require planning and resources to adequately address the overall indoor air quality concerns.

The following **short-term** measures should be considered for immediate implementation:

1. Examine each univent for function. Survey classrooms for univent function to ascertain if an adequate air supply exists for each room. Continue with plans to repair univent in classroom 9. Consider consulting a heating, ventilation and air conditioning (HVAC)

engineer concerning the calibration of univent fresh air control dampers throughout the school.

2. Operate all ventilation systems that are operable throughout the building continuously during periods of school occupancy and independent of thermostat control. To increase airflow in classrooms, set univent controls to “high”.
3. Inspect exhaust motors and belts for proper function. Continue with plans to repair and replace as necessary.
4. Remove all blockages from univents and exhaust vents to ensure adequate airflow.
5. Consider balancing mechanical ventilation systems every 5 years, as recommended by ventilation industrial standards (SMACNA, 1994).
6. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
7. Repair cracks/breaches in foundation to prevent water penetration, drafts and pest entry.
8. Move plants away from univents in classrooms. Avoid over-watering and examine drip pans periodically for mold growth. Disinfect with an appropriate antimicrobial where necessary.
9. Ensure bird’s nest is removed from air intake (Picture 14). Inspect to ensure surfaces are free of nesting materials and bird wastes. Clean and disinfect intake vents with an

appropriate antimicrobial where necessary. Consider installing wire mesh to prevent further roosting.

10. Seal/repair sink countertops to prevent water seepage. Observe countertops and interior of cabinets for water-damage and mold growth. Disinfect with an appropriate antimicrobial where necessary.

11. Change filters for air-handling equipment (e.g., univents, AHUs and ACs) as per the manufacturer's instructions or more frequently if needed. Vacuum interior of units prior to activation to prevent the aerosolization of dirt, dust and particulates. Ensure filters fit flush in their racks with no spaces in between allowing bypass of unfiltered air into the unit.

12. Consider upgrading filters in univents to disposable filters with a higher dust spot efficiency.

13. Clean/change filters for portable air purifiers as per the manufacturer's instructions or more frequently if needed.

14. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.

15. Store cleaning products properly and out of reach of students.

16. Consider adopting the US EPA (2000b) document, "Tools for Schools", to maintain a good indoor air quality environment on the building. This document can be downloaded from the Internet at: http://www.epa.gov/iaq/schools/index.html.

17. Refer to resource manuals and other related indoor air quality documents for further building-wide evaluations and advice on maintaining public buildings. Copies of these materials are located on the MDPH's website: http://mass.gov/dph/indoor_air

The following **long-term measures** should be considered:

1. Replace/repair window systems building-wide to prevent water penetration and drafts through window frames. Consider re-pointing and waterproofing exterior brickwork to prevent water intrusion. Weatherproofing materials should be applied during periods when the school is not occupied.
2. Contact an HVAC engineering firm for an assessment of the ventilation system's control system (e.g., controls, air intake louvers, thermostats). Based on the age, physical deterioration and availability of parts for ventilation components, such an evaluation is necessary to determine the operability and feasibility of repairing/replacing the equipment.
3. Consider providing local exhaust ventilation for photocopiers.

References

ACGIH. 1989. Guidelines for the Assessment of Bioaerosols in the Indoor Environment. Code Administrators International, Inc., Country Club Hill, IL.

ASHRAE. 1989. Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 62-1989

BOCA. 1993. The BOCA National Mechanical Code/1993. 8th ed. Building Officials and Code Administrators International, Inc., Country Club Hill, IL. Section M-308.1.1.

MDPH. 1997. Requirements to Maintain Air Quality in Indoor Skating Rinks (State Sanitary Code, Chapter XI). 105 CMR 675.000. Massachusetts Department of Public Health, Boston, MA.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

Schmidt Etkin, D. 1992. Office Furnishings/Equipment & IAQ Health Impacts, Prevention & Mitigation. Cutter Information Corporation, Indoor Air Quality Update, Arlington, MA.

SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

US EPA. 2000a. National Ambient Air Quality Standards (NAAQS). . US Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, DC. http://www.epa.gov/air/criteria.html.

US EPA. 2000b. Tools for Schools. Office of Air and Radiation, Office of Radiation and Indoor Air, Indoor Environments Division (6609J). EPA 402-K-95-001, Second Edition. http://www.epa.gov/iaq/schools/tools4s2.html

US EPA. 2001. Mold Remediation in Schools and Commercial Buildings. US Environmental Protection Agency, Office of Air and Radiation, Indoor Environments Division, Washington, D.C. EPA 402-K-01-001. March 2001.

ASHRAE. 1992. Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter. American Society of Heating, Refrigeration and Air Conditioning Engineers. ANSI/ASHRAE 52.1-1992.

MEHRC. 1997. Indoor Air Quality for HVAC Operators & Contractors Workbook. MidAtlantic Environmental Hygiene Resource Center, Philadelphia, PA.

Sanford. 1999. Material Safety Data Sheet (MSDS No: 198-17). Expo® Dry Erase Markers Bullet, Chisel, and Ultra Fine Tip. Sanford Corporation. Bellwood, IL.

Thornburg, D. 2000. Filter Selection: a Standard Solution. *Engineering Systems* 17:6 pp. 74-80.

Picture 1

Classroom Univent 1950’s Vintage

Picture 2

Univent Fresh Air Intake

Picture 3

Ceiling-Mounted Exhaust Vent

Picture 4

Wall-Mounted Exhaust Vent Partially Obstructed by Cabinet

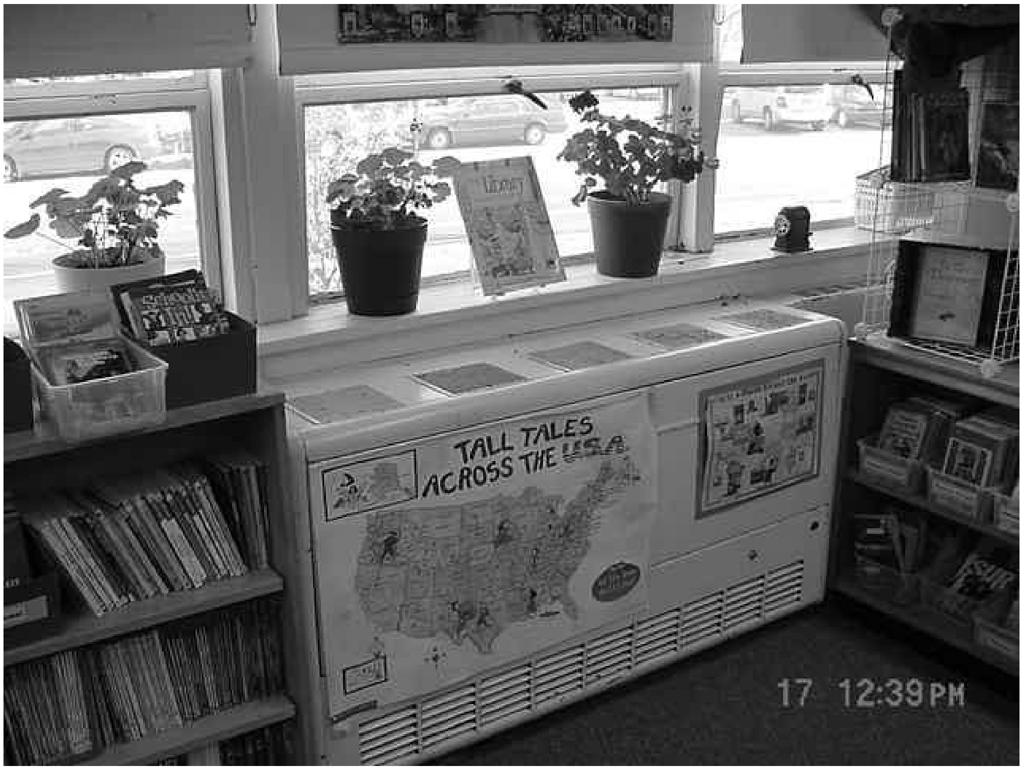
Picture 5

Classroom Exhaust Vent near Hallway Door

Picture 6

Air Handling Unit for Computer Room

Picture 7



Flowering Plants near the Air Stream of Univent Air Diffuser

Picture 8

Breach in Sink Countertop

Picture 9

Missing/Damaged Mortar around Brickwork

Picture 10

Large Wall Crack along Front of Building

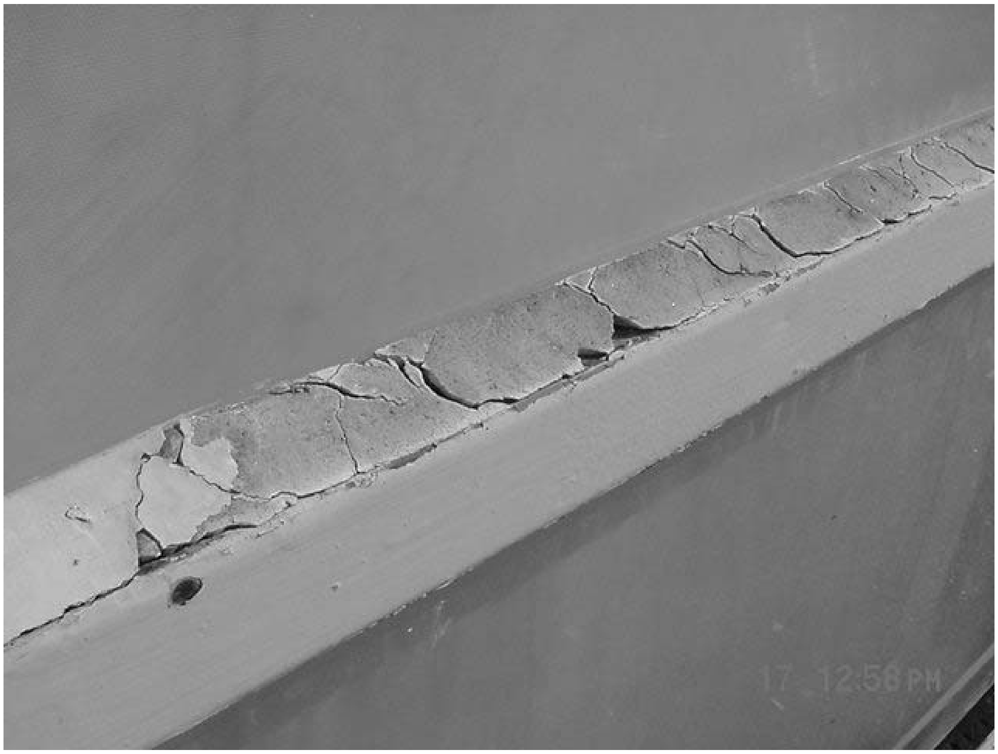
Picture 11

Missing/Damaged Window Caulking

Picture 12

Missing/Damaged Window Caulking

Picture 13

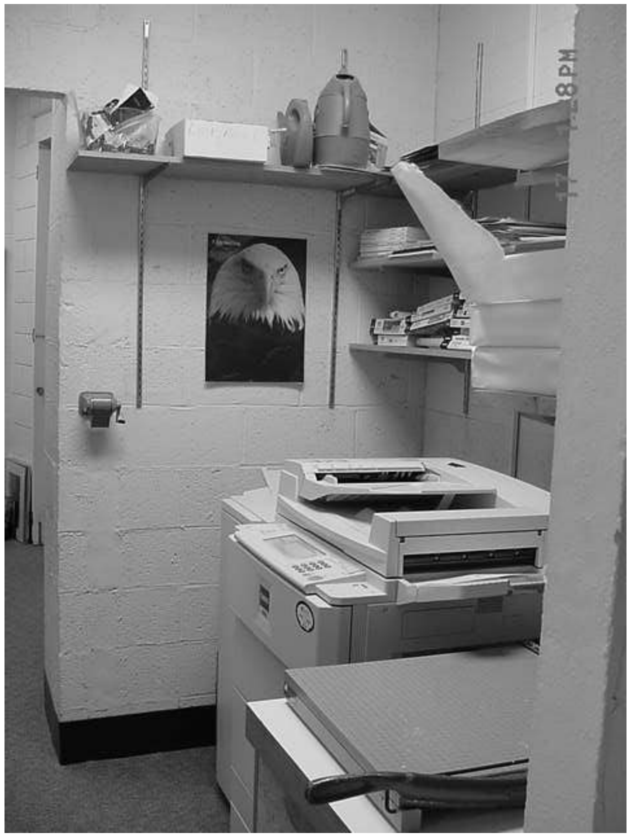


Missing/Damaged Window Caulking

Picture 14

Birds Nest in Intake Louvers for Gymnasium AHU

Picture 15



Photocopier in Alcove of Main Office

Picture 16

Spray Cleaning Products on Classroom Countertop

Picture 17

Metal/Mesh Filter in Classroom Univent

Field Elementary School | **Indoor Air Results**

99 School Street, Weston MA 02493 | **Date: 11/17/2005**

Table 1

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
background		46	33	395	ND	ND	10				mostly sunny, cool, westerly winds 5-10 mph, gusts up to 20-25 mph, assessment occurred the morning after heavy rain and gusty winds.
9	21	74	35	792	ND	ND	14	Y # open: 0 # total: 6	Y univent (off)	Y ceiling location	Hallway DO, breach sink/counter, AP, DEM, UV-on repair list, recommended use of windows to introduce fresh air, metal/mesh filters in UV, no visible evidence of water damage/mold growth, no associated odors detected.
library	25	74	35	682	ND	ND	13	Y # open: 0 # total: 20	Y wall	Y wall	Hallway DO, DEM, dehumidifier, water stains on pipe wrap.
7	21	70	33	794	ND	ND	10	Y # open: 0 # total: 7	Y	Y ceiling (off)	Hallway DO, DEM, exhaust motor deactivated-on repair list.

ppm = parts per million
µg/m3 = micrograms per cubic meter

AD = air deodorizer
AP = air purifier
aqua. = aquarium

AT = ajar ceiling tile
BD = backdraft
CD = chalk dust
CP = ceiling plaster
CT = ceiling tile
DEM = dry erase materials

design = proximity to door
FC = food container
G = gravity
GW = gypsum wallboard
M = mechanical
MT = missing ceiling tile

NC = non-carpeted
ND = non detect
PC = photocopier
PF = personal fan
plug-in = plug-in air freshener
PS = pencil shavings

sci. chem. = science chemicals
TB = tennis balls
terra. = terrarium
UF = upholstered furniture
VL = vent location
WP = wall plaster

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Field Elementary School | **Indoor Air Results**

99 School Street, Weston MA 02493 | **Date: 11/17/2005**

Table 1

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
computer room	25	74	34	736	ND	ND	17	Y # open: 0 # total: 8	Y wall	Y wall	DEM.
3	2	72	32	782	ND	ND	14	Y # open: 0 # total: 7	Y univent	Y wall	Hallway DO, DEM, 20 occupants gone 2 mins.
20	26	73	38	782	ND	ND	18	Y # open: 0 # total: 7	Y univent items	Y wall	Hallway DO,
26	21	74	34	883	ND	ND	12	Y # open: 0 # total: 8	Y univent (off)	Y wall	Hallway DO, DEM, PF, plants.
27	23	76	33	789	ND	ND	13	Y # open: 0 # total: 10	Y univent	Y wall	Hallway DO, DEM, cleaners, plants.
25	23	70	33	779	ND	ND	19	Y # open: 0 # total: 12	Y univent	Y wall	DEM.
21	0	74	31	658	ND	ND	14	Y # open: 0 # total: 8	Y univent (off)	Y wall	plants.

ppm = parts per million
µg/m3 = micrograms per cubic meter

AD = air deodorizer
AP = air purifier
aqua. = aquarium

AT = ajar ceiling tile
BD = backdraft
CD = chalk dust
CP = ceiling plaster
CT = ceiling tile
DEM = dry erase materials

design = proximity to door
FC = food container
G = gravity
GW = gypsum wallboard
M = mechanical
MT = missing ceiling tile

NC = non-carpeted
ND = non detect
PC = photocopier
PF = personal fan
plug-in = plug-in air freshener
PS = pencil shavings

sci. chem. = science chemicals
TB = tennis balls
terra. = terrarium
UF = upholstered furniture
VL = vent location
WP = wall plaster

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Field Elementary School

99 School Street, Weston MA 02493

Table 1

Indoor Air Results

Date: 11/17/2005

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
art	1	74	33	733	ND	ND	12	Y # open: 1 # total: 10	Y univent	Y wall	Hallway DO, kiln, plants.
music	20	73	39	1027	ND	ND	17	Y # open: 0 # total: 5	Y univent (off)	Y wall	
14	23	72	27	617	ND	ND	9	Y # open: 2 # total: 7	Y univent	Y wall	Hallway DO, DEM, cleaners.
16	22	72	28	715	ND	ND	12	Y # open: 4 # total: 8	Y univent plant(s)	Y (off)	DEM, plants, exhaust motor deactivated-on repair list.
15	20	75	32	688	ND	ND	11	Y # open: 0 # total: 12	Y univent	Y wall	Hallway DO, DEM, cleaners.
18		72	31	633	ND	ND	11	Y # open: 0 # total: 7	Y univent	Y wall location	DEM, cleaners.
10	25	75	36	974	ND	ND	19	Y # open: 0 # total: 7	Y univent (off)	Y wall	Hallway DO, DEM.

ppm = parts per million
µg/m3 = micrograms per cubic meter

AD = air deodorizer
AP = air purifier
aqua. = aquarium

AT = ajar ceiling tile
BD = backdraft
CD = chalk dust
CP = ceiling plaster
CT = ceiling tile
DEM = dry erase materials

design = proximity to door
FC = food container
G = gravity
GW = gypsum wallboard
M = mechanical
MT = missing ceiling tile

NC = non-carpeted
ND = non detect
PC = photocopier
PF = personal fan
plug-in = plug-in air freshener
PS = pencil shavings

sci. chem. = science chemicals
TB = tennis balls
terra. = terrarium
UF = upholstered furniture
VL = vent location
WP = wall plaster

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Field Elementary School | **Indoor Air Results**

99 School Street, Weston MA 02493 | **Date: 11/17/2005**

Table 1

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	TVOCs (ppm)	PM2.5 (µg/m3)	Windows Openable	Ventilation		Remarks
									Supply	Exhaust	
gym	50	72	35	777	ND	ND	19	N	Y ceiling	Y ceiling	

ppm = parts per million
µg/m3 = micrograms per cubic meter

AD = air deodorizer
AP = air purifier
aqua. = aquarium

AT = ajar ceiling tile
BD = backdraft
CD = chalk dust
CP = ceiling plaster
CT = ceiling tile
DEM = dry erase materials

design = proximity to door
FC = food container
G = gravity
GW = gypsum wallboard
M = mechanical
MT = missing ceiling tile

NC = non-carpeted
ND = non detect
PC = photocopier
PF = personal fan
plug-in = plug-in air freshener
PS = pencil shavings

sci. chem. = science chemicals
TB = tennis balls
terra. = terrarium
UF = upholstered furniture
VL = vent location
WP = wall plaster

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

TABLE 2

Temperature Relative Humidity and Moisture Test Results*
Weston, Field Elementary School
November 17, 2005

Location	Temp (°F)	Relative Humidity (%)	Moisture Measurement	Material/Comments
Outdoors	46	33		mostly sunny, cool, westerly winds 5-10 mph, gusts up to 20-25 mph, assessment occurred the morning after heavy rain and gusty winds.
9	74	35	No - Low So – Low East – Low West – Low Center - Low	Carpeting, no evidence of water infiltration, damage, mold growth or associated odors
7	70	33	No - Low So – Low East – Low West – Low Center - Low	Carpeting, no evidence of water infiltration/damage, mold growth or associated odors